RETAINING WALL - MODULAR UNIT REINFORCED EARTH TENSAR GEOGRID REINFORCEMENT

Final Report
For
HR-549

January 1998

Project Development Division

Iowa Department of Transportation

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RETAINING WALL - MODULAR UNIT REINFORCED EARTH TENSAR GEOGRID REINFORCEMENT

BLAIRS FERRY ROAD/LINDALE DRIVE INTERSECTION RECONSTRUCTION PROJECT
MARION, IOWA
M-MG-0820(4)--8X-57

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Engineering Department

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7. ACKNOWLEDGMENT OF COOPERATING ORGANIZATIONS

8. ABSTRACT

This research, initiated in October 1992, was located at the intersection of Blairs Ferry Road and Lindale Drive in the City of Marion. The wall is located on the southeast corner of the intersection. Reinforced retaining wall construction started with a five inch base of roadstone with one inch of sand for leveling purposes. One and one-half to two feet of one inch clean stone was placed behind the blocks. A four inch perforated plastic pipe was placed approximately nine inches from the bottom of the one inch clean stone. The Tenswal, tensar geogrid was placed at every third layer. Openings in the Tenswal are hooked over plastic dowels in the blocks. The tenswal reaches from the face of the wall back 5' to 8'. The cost for constructing this wall was $124,400. The wall has performed well for the past five years. The wall improves the aesthetics of a high traffic volume intersection of an urban area. Many positive comments have been received by the city regarding its appearance. The City of Marion has been pleased with the wall and has used this type of wall on subsequent projects.

9. KEY WORDS

Reinforcement
Tenswal
Retaining wall
Geogrid

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11

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DISCLAIMER

INTRODUCTION

This is the final report on the construction and performance of a Tensar fabric-reinforced soil retaining wall with modular concrete block facing units constructed in the City of Marion.

The modular retaining wall was investigated originally as an alternative to a conventional cast-in place reinforced concrete retaining wall to support a 10 foot high embankment. Preliminary cost estimates determined approximately equal costs for both. The modular design was selected based upon aesthetic appearance in the high traffic volume intersection.

Analysis and design was performed by Ament Engineering, Inc. of Cedar Rapids, Iowa. The design analysis determined the spacing and strength of geogrid necessary to resist the lateral earth pressures and surcharge loads of the existing soils. Technical support during design and construction was provided by Kings Material, Inc., Contech Construction Products and Terracon Consultants.

The wall was constructed as a part of an intersection reconstruction project, M-MG-0820(4)--8X-57, in 1993. The prime contractor was Rathje Construction Company of Marion, Iowa; subcontractor constructing the retaining wall was Anne Duffield Construction, Inc. of Cedar Rapids, Iowa. The project location is the intersection of Blairs Ferry Road and Lindale Drive in the City of Marion. The wall is located on the southeast corner of the intersection.

In conjunction with this project, three individual walls were constructed. Two were approximately 24 inches in exposed height and did not require Tensar reinforcement. This report deals primarily with the large Tensar-reinforced wall.

CONSTRUCTION

Excavation of the existing soil was made to the bottom of the footing elevation. Existing soils were proof rolled for stability testing. The 6" x 36" wall footing material was a five inch thickness of 1 inch granular material topped with 1 inch of fill sand for grading and leveling purposes. All base materials were compacted.

Modular block units were set and checked for position and levelness. Upon completion of the first row of block, the block unit openings were filled with 3/8 inch minus aggregate and hand tamped with hammers. Compactive efforts within the block units were limited by the size of the openings.

A corrugated polyethylene draintile was installed behind the base row of block to facilitate drainage. The tile was discharged into a storm sewer. Backfill behind the wall was placed as each row of block was installed. A free draining material (1 inch clean aggregate) was placed immediately behind the wall. Backfill over the geogrid was a 3/4 inch minus aggregate which was compacted.

Successive rows of block were anchored with fiberglass dowels, ½" x 9¼", inserted into the head sections of each block from the previous row to prevent horizontal shifting of the blocks. Each successive row of blocks straddled two block units from the row underneath and were set back one inch. The ends of each wall were bent or curved into the backfill for visual purposes.

Tensar geogrid fabric was placed at the elevations and lengths specified. The end of the grid was looped over the block units dowels and the fabric was stretched tight behind the wall. In curved sections, geogrid sheets were overlapped in order to keep their alignment relatively perpendicular to the face of the wall.

Cap units topped the upper row of standard blocks. These units have solid tops with drilled holes for dowels in their underside. One foot of native topsoil was placed on top of the completed backfill to minimize surface water infiltration behind the wall.

A wooden fence was constructed on top of the embankment with posts anchored approximately 30 inches behind the wall cap units.

The majority of the construction was performed with hand labor. Each block unit must be individually set and checked for position and levelness. Survey for elevations and alignment of the wall base was critical.

Appendix A shows a typical cross-section of the wall and photograph of the step-by-step construction of the wall.

MONITORING

Reference points for monitoring horizontal and vertical displacement of the large retaining wall were established. Biannual checks of elevations and measurements were made in a three year period. Overall visual inspections were also performed.

No significant irregularities have been noted in the vertical or horizontal alignment of each row or vertical projection during this inspection period. The offset of each successive row of blocks appears to be maintained. No leakage between block units or separation of block units is apparent. Some drainage through the blocks down the face of the wall is visible after extended periods of precipitation, however, most drainage is through the backfill behind the wall into the base draintile.

One concern noted in the first year monitoring report was vegetative growth occurring between some block units. An annual application of weed killer to the face of the wall has eliminated this problem.

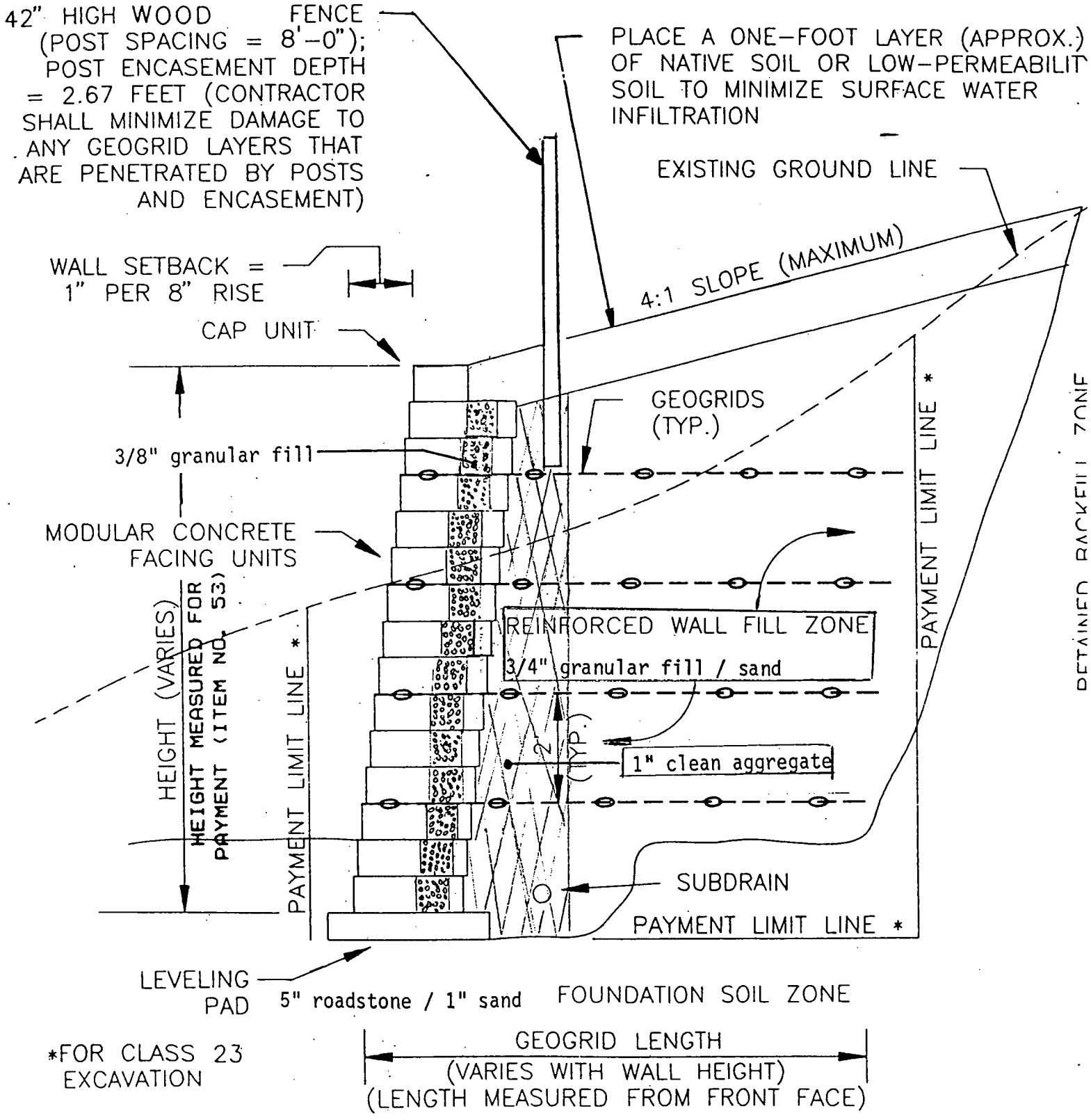
CONCLUSION

Final cost of the completed large wall was $124,400. While there were no significant (estimated) cost savings between this type of construction and conventional cast-in-place construction, the aesthetic effects have a significant value.

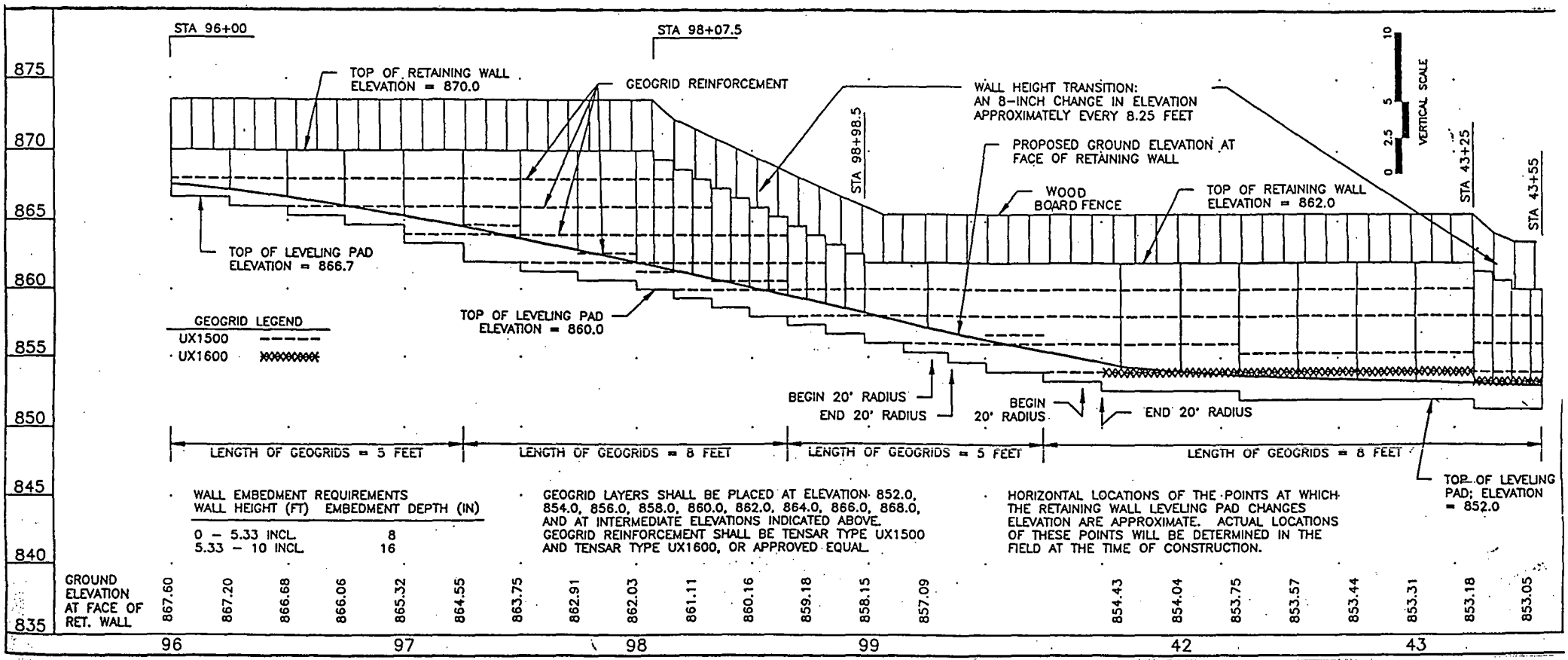
The wall has performed well in the past five years. Its location is in a high traffic volume intersection of an urban area which allows great visibility. Many positive comments have been received by the City regarding its appearance.

The City of Marion is pleased with the construction and has used this type of wall construction on other projects.

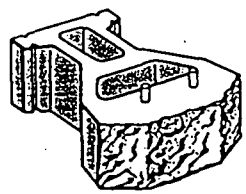
Appendix A
Step-by-Step Construction of the Wall



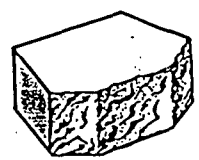
TYPICAL SECTION OF RETAINING WALL



PLAN VIEW - LARGE RETAINING WALL



STANDARD UNIT



CAP UNIT

BLOCK UNIT DATA

GENERAL INFORMATION:

- Compressive Strength ..... 3000 psi
- Absorption Rate ..... 6 to 8 lbs/ft³
- Composition ..... High Strength, High Density Concrete

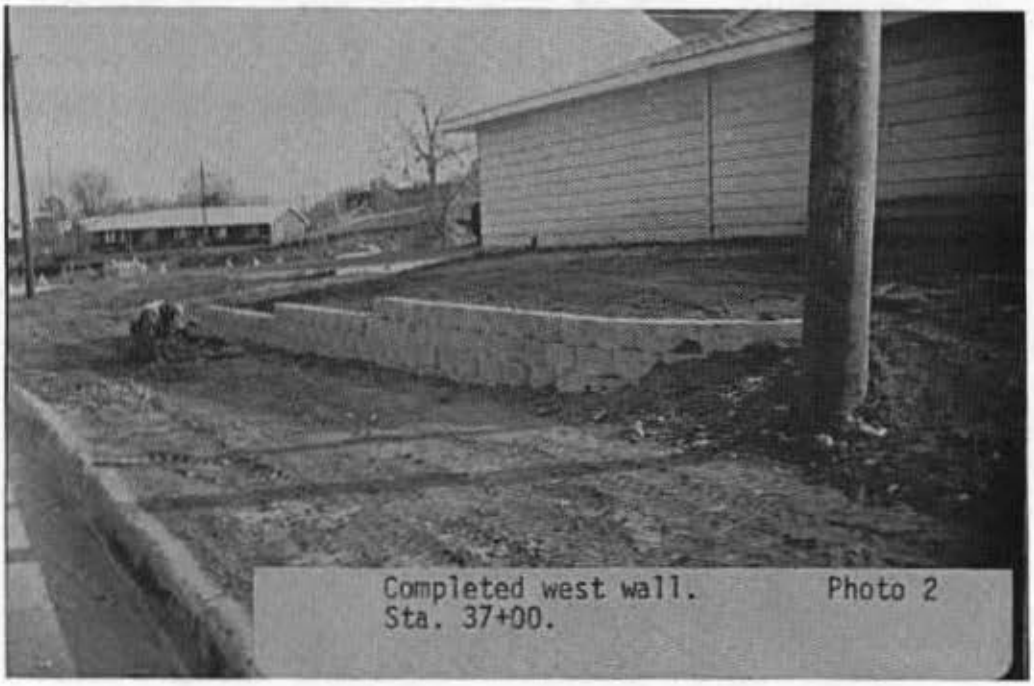
STANDARD UNIT:

- Weight ..... 94 lbs..... (42.64 kg)**
- Size ..... 8"H x 18"W x 24"D ..... (.2032m H x .4572m W x .6096m D)**
- Exposed Face Area ..... 1 Square Foot (8"x18").. .093 Square Meters (.2032m x .4572m)

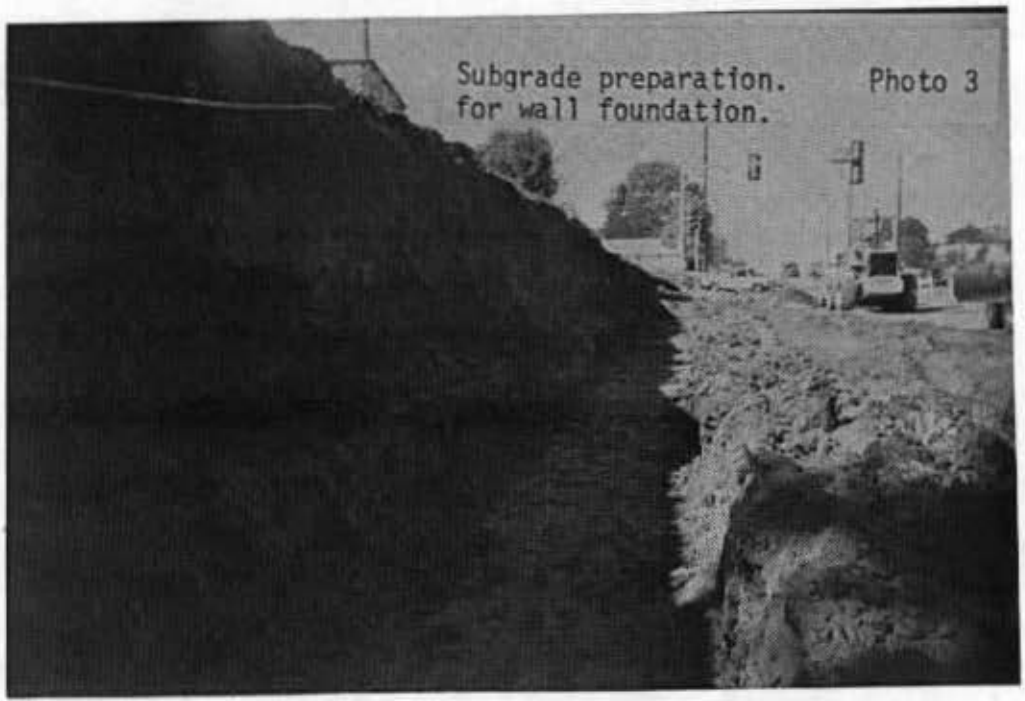
CAP UNIT:

- Weight ..... 78 lbs..... (35.38 kg)**
- Size ..... 8"H x 18"W x 12"D ..... (.2032m H x .4572m W x .3048m D)**
- Exposed Face Area ..... 1 Square Foot (8"x18").. .093 Square Meters (.2032m x .4572m)

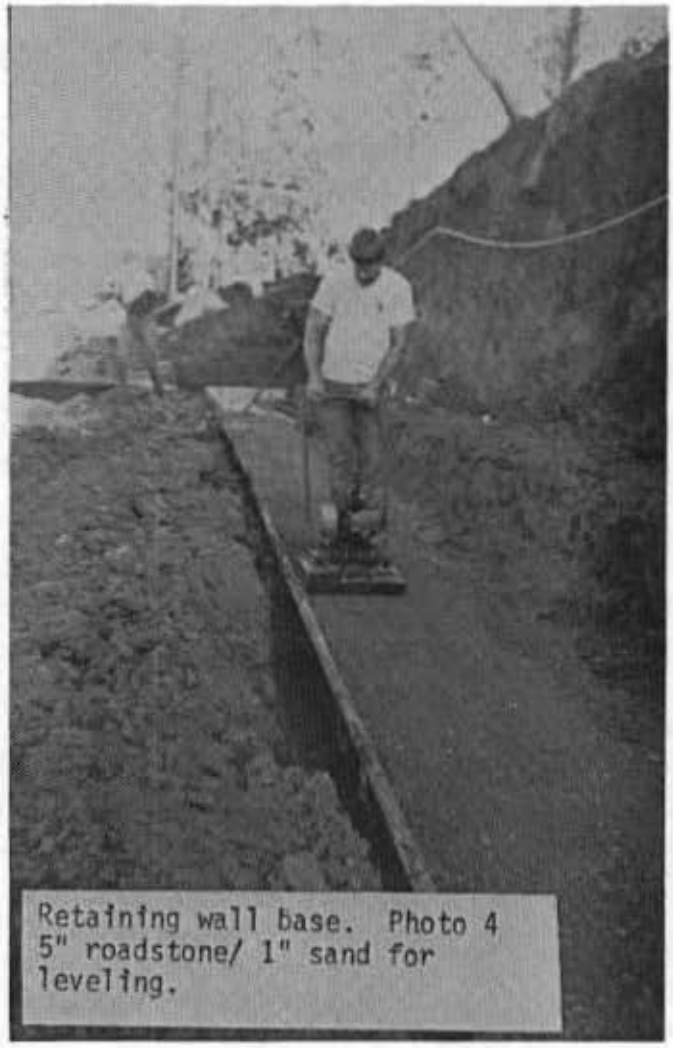
Complete east wall. Photo 1
Sta. 44+75.



Completed west wall. Photo 2
Sta. 37+00.

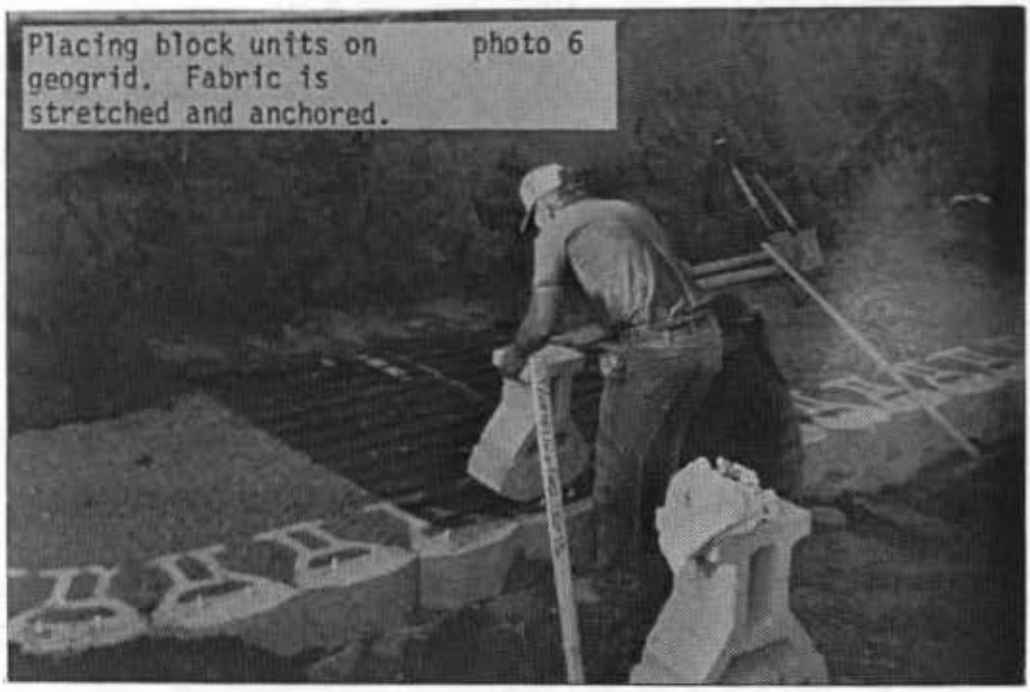


Subgrade preparation. Photo 3
for wall foundation.

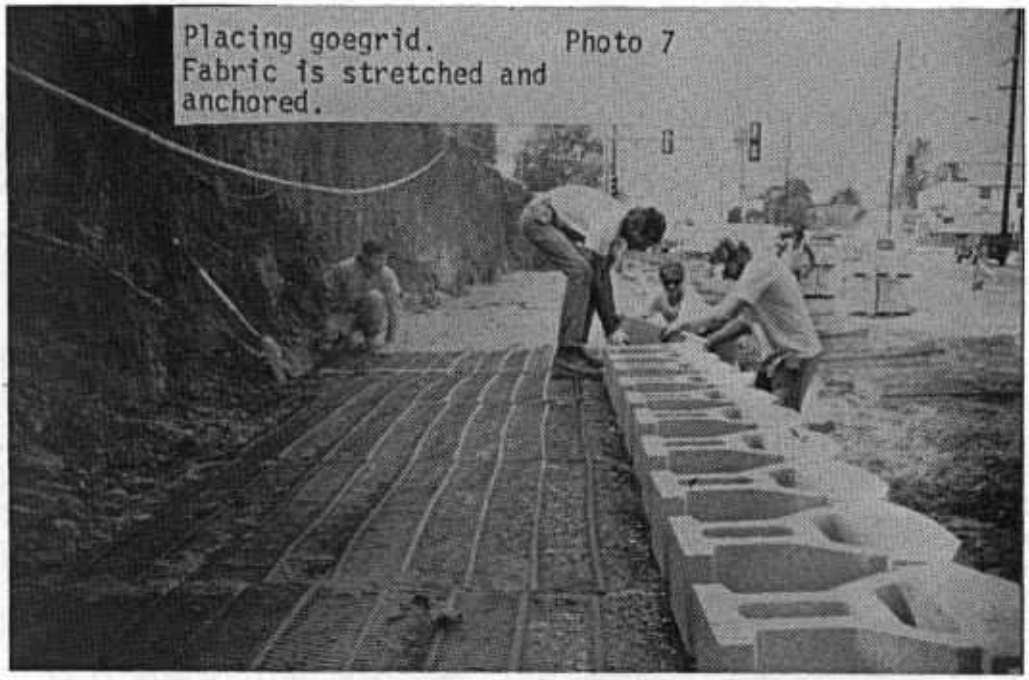


Retaining wall base. Photo 4
5" roadstone/ 1" sand for leveling.

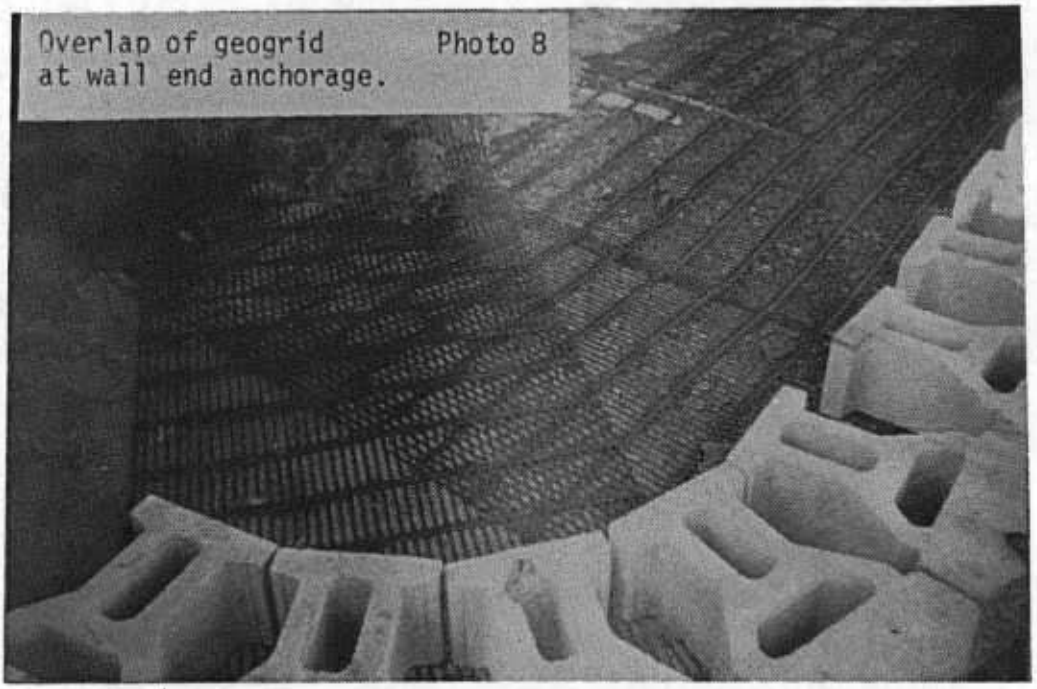
Base foundation. Photo 5
Base layer of block units.
4" subdrain tile.



Placing block units on geogrid. Fabric is stretched and anchored. photo 6

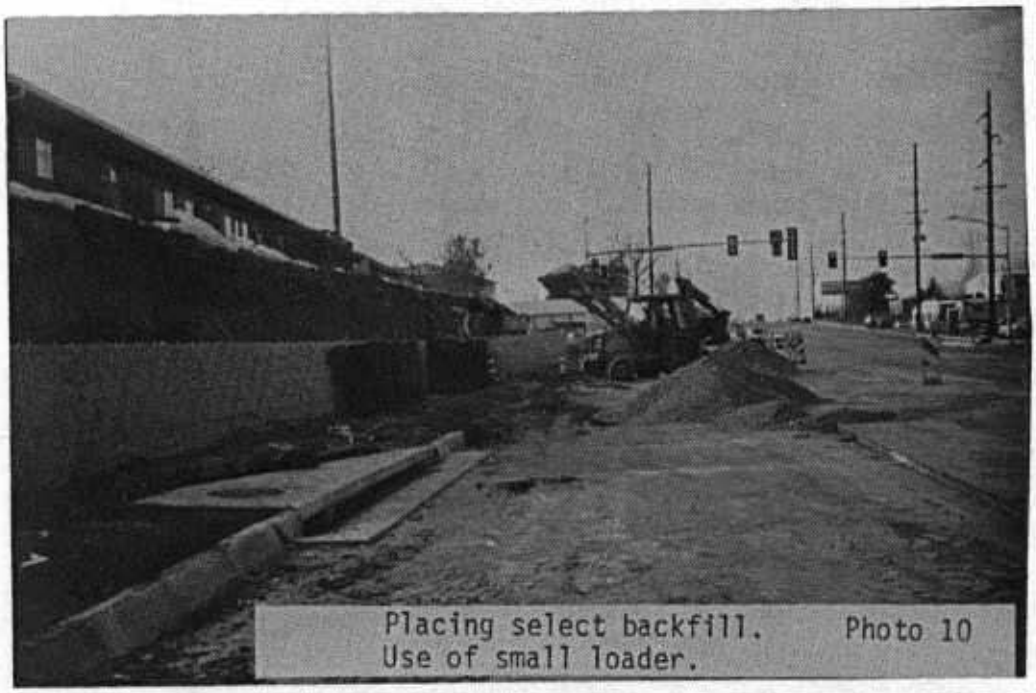


Placing goegrid. Photo 7
Fabric is stretched and
anchored.

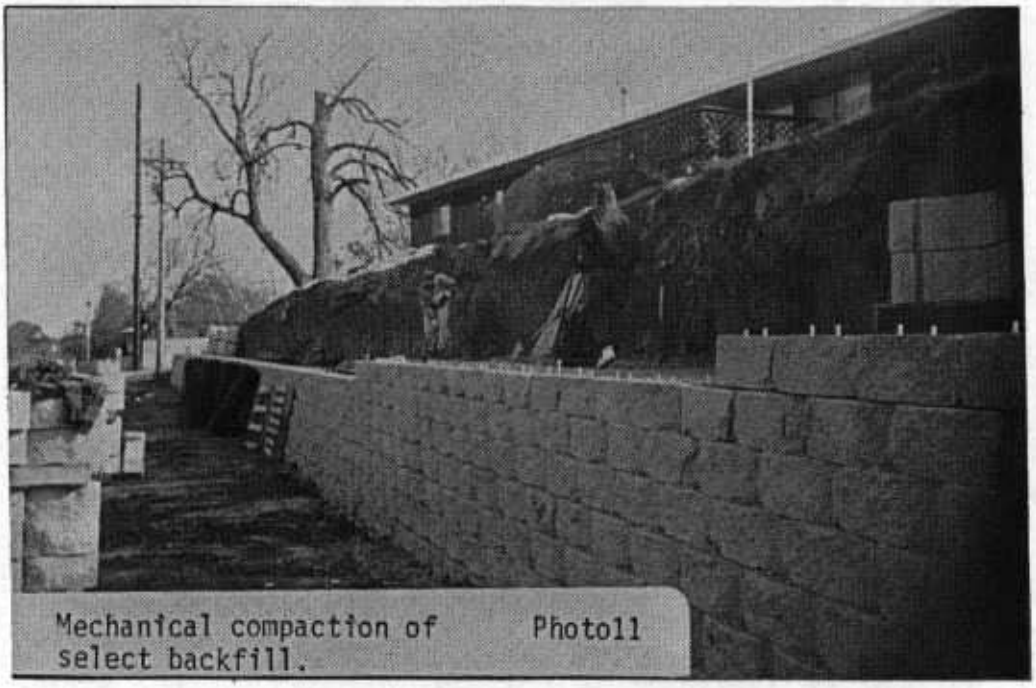


Overlap of geogrid Photo 8
at wall end anchorage.

Backfill. 1" clean Photo 9
at draintile. Sand select
over geogrid.



Placing select backfill. Photo 10
Use of small loader.



Mechanical compaction of Photo11
select backfill.

Complete wall looking Photo 12
SE. Sta. 43+00.

Completed Wall looking SE. Sta. 41+50. Photo 13